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THE COMPARATIVE EFFECTS OF DIFFERENT
MODES OF PRESENTATION ON EFFICIENCY
OF LEARNING AND RETENTION

by

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A THESIS

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The undersigned certify that they have read, and
recommended to the Faculty of Graduate Studies for acceptance,
a thesis entitled "The Comparative Effects of Different Modes
of Presentation on Efficiency of Learning and Retention"
submitted by David L. Burt in partial fulfilment of the
requirements for the degree of Master of Education.

ABSTRACT

This study was undertaken in an attempt to determine the comparative effectiveness of each of three single channel modes of communication. The modes employed were visual-verbal (print or T₁), visual-non-verbal (picture or T₂) and audio-verbal (spoken word or T₃). Effectiveness was measured by the number of errors made in learning a list of paired-associate tasks, and by retention of the learning measured at four different time intervals.

One hundred and twenty grade eight students were randomly placed in three treatment groups and four post-test groups.

	Immediately	20 min.	48 hr.	.7 days
Treatment 1	10	10	10	10
Treatment 2	10	10	10	10
Treatment 3	10	10	10	10

During the learning phase of the presentation, the stimulus and response halves of the learning tasks were presented together. The subjects were presented the constant stimulus half of the paired-associates in the form of a projected, printed word. The response half of the pair was simultaneously presented as a printed word, as a picture, or as a spoken word depending on the treatment group of which the subject was a member. Each subject was exposed to only one response mode.

To test the subject, the printed stimulus word was presented and the student responded by selecting the printed word, picture, or by

saying the correct response -- again depending on the mode by which the learning task had been presented. As each pair was "learned", to a criterion of two successive correct responses, it was eliminated from the presentation. A constant score was kept of each response until all pairs were "learned."

Each subject was post-tested once, according to the post-test group to which he had been assigned.

The data was analyzed using a p x q x r factorial design using the errors to criterion in the first analysis and score on delayed post-test in the second analysis.

The results indicated that in the sample of grade eight students those who were taught the printed, low-meaningfulness stimulus word with picture response had significantly fewer errors to criterion than those students who were presented the learning tasks with either the printed or spoken word responses. There was no statistically significant difference in the number of errors to learning criterion indicated between the students who learned using the visual-verbal (print) or the auditory-verbal (spoken) response modes. After a period of seven days the group who had the picture as a response mode scored significantly better than either spoken word or printed word response mode groups.

Scores in treatments 1 and 3 at the end of the seven day delay post-test period were significantly different from scores at each of the other delay test periods. In treatment 2 no one delay test score differed from any other over the entire seven day period.

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Each of the principals who co-operated in the project deserves individual thanks for his willingness to help us to the extent that this project demanded. We were well received and given the assistance that was so necessary in a project that depends on a strict time schedule.

Mention must be made of the assistance given by the personnel in the A-V Media Center of the Faculty of Education in supplying and modifying some of the equipment used in this project.

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D.L.B.

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CHAPTER I

INTRODUCTION TO THE STUDY

I. GENERAL STATEMENT OF THE PROBLEM

One of the tasks faced by the classroom teacher is the efficient presentation of subject content and, at a later date, the testing of retention of that material to see how effective the teaching has been. The teacher has at his command several channels of communication. Two channels most commonly used are the audio and the visual. The problem in this thesis is to explore the comparative advantages of each of these channels with regard to how quickly selected material is learned and how well it is retained.

II. BACKGROUND OF THE PROBLEM

The communication process involves four major elements: source, message, channel and receiver.¹ Because communication is a process, changes in any of the elements may affect the outcome of the communication. In this regard Knowlton suggests that research should be aimed at the message component.² It should be realized, however, that changing the form of the message may result in the utilization of a different channel or of a combination of channels.

¹ David K. Berlo, The Process of Communication, (New York: Holt,

The two channels of communication generally used in education are the audio and the visual. Hartman suggests that each of these channels may be subdivided into the verbal and the non-verbal.³ The message component may, therefore, be encoded or decoded four different ways. The following table illustrates the possibilities:

TABLE I

STIMULUS AND RESPONSE MODES FOR AUDIO-VISUAL
PAIRED-ASSOCIATE LEARNING TASKS

		Stimulus			
		Visual		Audio	
		Verbal	Non-Verbal	Verbal	Non-Verbal
Response	Visual	Verbal			
		Non-Verbal			
Response	Audio	Verbal			
		Non-Verbal			

Teaching may be considered as the practical application of communication theory. Effective classroom communication is of lasting importance to the individual student in maintaining his desire to complete his education and thus, research must be directed at discovering methods of efficiently presenting masses of information that will be retained over a period of time.

Rinehart and Winston, 1960) pp. 63-70, 72-73.

² J.Q. Knowlton, A Conceptual Scheme for the Audio-Visual Field (School of Education, Indiana University, 1964), pp. 4-5.

³ F.R. Hartman, "Single and Multiple Channel Communication: A

III. FORMAL STATEMENT OF THE PROBLEM

The main purpose of this study was to investigate the comparative advantages of each of three modes of presenting similar learning tasks. The three modes employed were visual-verbal (print, T_1), visual-non-verbal (picture, T_2) and auditory-verbal (spoken word, T_3). The effectiveness of each mode was studied with regard to a) efficiency, measured by the number of errors each subject made while learning the tasks to the learning criterion and b) retention, measured by score on a delayed post-test. Another consideration of this study was an investigation of the relationship of sex differences to efficiency of learning and retention.

IV. HYPOTHESES TO BE TESTED

Hypothesis I. There is no significant difference in the number of errors made in reaching learning criterion:

- A. Between sexes.
- B. When the tasks are presented in print
(Treatment 1, or T_1), pictorially
(Treatment 2 or T_2), or auditorially
(Treatment 3 or T_3).
- C. In the delayed post-test groups.

Hypothesis II. There is no significant difference in the score on the delayed post-test:

- A. Between sexes.
- B. When the tasks are presented in print (T_1), pictorially (T_2) or auditorially (T_3).
- C. In the delayed post-test groups.

V. DEFINITION OF TERMS

Criterion of learning: A behavioral goal by which progress is judged, an external basis for judgment. In this study, two successive correct responses to each stimulus member is considered a criterion measure of learning.

Paired-associate procedure: Items (verbal, visual or auditory) are presented in pairs for learning, then the stimulus of each pair (usually not in the original sequence) is presented for a brief time and the subject endeavors to reproduce the appropriate response. In this study the response was not reproduced but was selected in a multiple choice type of test.

Test: The term is used to identify that part of the procedure within the learning phase which determines when the criterion measure of learning has been reached.

Post-test: Test after learning to criterion. In this study the subjects were divided into four post-test groups: immediate, twenty minutes, forty-eight hours and seven days.

Immediate post-test: Since the criterion of learning in this study was two successive correct responses for each item, immediate post-test must be defined and understood as a test of all items immediately after the last learning task has been learned to the criterion. It is understood and acknowledged that some items may have been removed from the learning tasks some time before the "immediate" post-test.

Error: During the testing and post-testing, each subject was required to select the response member that matched the displayed stimulus member. If an incorrect response member was selected or if no response member was chosen, an error was recorded against the subject in the appropriate column opposite the stimulus-response pair on the individuals score sheet (see appendix D).

Visual-verbal: Printed words: the mode of presenting all stimulus members and the response mode for treatment 1.

Visual-non-verbal: A picture. The mode of presenting the response member for treatment 2.

Auditory-verbal: The spoken word. The mode of presenting the response member for treatment 3.

Auditory-non-verbal: Noise and/or music. This mode was not used in this study.

Treatment: In this study each of the three treatment groups had a visual-verbal stimulus mode: Treatment group 1 had a visual-verbal response mode. Treatment group 2 had a visual-non-verbal response mode. Treatment group 3 had an auditory-verbal response mode.

35 mm. slides: a) Learning-task slides: These are slides of the paired-associate learning tasks for treatments 1 and 2, and include the visual-verbal half of each pair for treatment 3. b) Stimulus test slides: These slides were the visual-verbal, or stimulus, half of each task for all three treatments. The slides were used in testing the subjects to the learning criterion and in the delayed post-test. c) Response slides: These were slides of the response half of each pair for treatments 1 and 2.

VI. DELIMITATION OF THE STUDY AND CONTROLLED FACTORS

The study took the following factors into consideration:

1. Presentation and testing time: In order to make the results from the modes of presentation more comparable, the amount of time for presenting the learner with the individual learning tasks and later for testing the responses was controlled for every mode. The control was as follows:

- a) each learning task slide was shown for five seconds.
- b) each of the multiple choice response items was shown for one second.

Since there was a learning criterion of two successive correct responses, the total time required for each student to learn the tasks varied. The control was one of exposure to the materials until learned to the criterion.

2. Method of presenting and testing the learning tasks: In most testing situations involving the spoken word as compared to either print or pictorial presentations, a subject is at a disadvantage since the word

is said and is gone. In this study a testing technique was developed which would make the tasks more equivalent.

A multiple choice examination procedure was developed which was comparable for every testing mode. During testing the individual subjects were shown the visual-verbal or visual-non-verbal response items according to the way they had been taught. The response items were displayed for a period of one second. The subjects were required to select the correct responses by pushing a button. The subjects in the auditory-verbal group listened to the same choices spoken at one second intervals and were required to say the response.

3. Order of presentation: In all cases, the learning tasks, the testing stimulus slides and the multiple choice response slides were presented in random order. By using two 35 mm. slide projectors and by randomizing the slides between each showing the serial order effects were minimized.

4. Feedback: As the student responded to each stimulus test slide, an assistant recorded the correctness of the response. The student, however, was not informed of the acceptability of his response. There was no feedback during the first two presentations in the learning situation. When items began to "drop out" of the learning presentation sequence (following two successive correct responses) a certain amount of feedback was implied by the very absence of an item.

5. Overt response during learning: The subjects were asked not to say or write anything during the presentation of the learning task slides.

6. Difficulty level: The difficulty level of the visual-verbal material was known since the words were taken from Nobel's list of disyllables.⁴ Since Nobel derived values of meaningfulness using university students, it would seem that the meaningfulness levels for that population may not apply directly to the sample tested here.

7. Overlearning: To control this factor the subjects were taught and tested individually. By getting immediate knowledge of the subjects level of performance and by instituting the criterion level of two successive correct responses, all subjects should have been brought to the same level of learning.

8. Testing mode: The testing mode was the same as the teaching mode in every treatment.

9. Audio presentation and testing: The response half of each pair was said into a microphone and the multiple choice responses were tape recorded so that the subject would not gain additional cues from the examiner's facial expression. In addition the subject was faced away from the examiner. This control was instituted in order to eliminate a concern expressed by Hartman that intelligibility may be increased if the subject is permitted to observe the lips or facial expression of the speaker.⁵

4

B.J. Underwood and R.W. Schulz, Meaningfulness and Verbal Learning. (Philadelphia: Lippincott, 1960), p.331.

5

Hartman, op.cit. p.239.

VII. LIMITATIONS OF THIS STUDY

1. Motivation: No attempt was made to extrinsically motivate the subjects. Nor was there any attempt to measure the degree of motivation inherent in their being selected to participate in the study.

2. Prompting: There was no prompting or cueing in order to help the subjects when either the stimulus test slides or the post-test slides were shown.

3. Personal factors: No attempt was made to establish intelligence quotients, socio-economic status, achievement ratings, motivational level or exact age level.

CHAPTER II

RELATED RESEARCH AND JUSTIFICATION FOR THE STUDY

I. RELATED RESEARCH

Audiovisual Research in Single Channel Communication

Most of the research in the audiovisual field is exemplified by the concern with evaluating effectiveness of learning after similar material has been presented by a teacher as compared with a mediating device such as radio or television, or by a particular medium such as 16mm film as compared with study prints. The third edition of the Encyclopedia of Educational Research devotes twenty-three pages to audio-visual research, and none of the studies documented compares the effectiveness of single channels of communication.¹

There have however, been studies which have considered the more basic problem of the comparative effectiveness of the audio or visual channels in teaching. Frank R. Hartman states that of fourteen studies comparing the effectiveness of the print and audio channels using nonsense syllables and digits, eight studies reported the print more effective, five favoured the audio and one found no significant difference. Because the results favouring audio were achieved with young children and those favouring print were achieved with older

¹ C.W. Harris (ed.), Encyclopedia of Educational Research, Third Edition (New York: Macmillan Co., American Educational Research Association, 1960) pp.115-137.

children or adults, he reports that the results are not strictly comparable.²

Of fifteen studies comparing audio and print using meaningful words, eight found the print more effective, three favoured audio and four found no significant differences. Hartman observes that "the studies supporting the audio channel used material suitable for young children" and, with the exception of one study, those favouring the print channel were all derived from studies using adult subjects. In every study reporting a print advantage the material is relatively complex.³ A summary of these studies indicated that "the print channel becomes more effective relative to the audio as the difficulty of the material for the subjects increases, provided a fair degree of literacy is present."⁴ In summarizing the fourteen studies comparing the pictorial mode with the print and audio, he indicates that five found the picture better than print, six found the picture better than audio, and three found no consistent differences.

Though the majority of this research does tend to favour the pictorial, Hartman suggests that some caution is necessary in interpreting the results. The reasons for his lack of confidence in the findings are: 1) there are few studies, 2) the older studies are defective in experimental design, 3) the testing always involved verbal items, (disadvantaging

² Hartman, op.cit. p.237. ³ Ibid.

⁴ Hartman, op.cit. p.237.

the pictorial channel), and 4) the relative difficulty of the pictorial and verbal information was neither known nor controlled.⁵

In discussing the studies in general, Hartman indicates that:

Some inconsistencies are perhaps the result of vagaries of sampling; others may be a product of weaknesses in experimental design including lack of randomization, improper control of conditions, insufficient number of repetitions,⁶ invalid or unreliable tests, and a lack of probability statements.

He further suggests that two possible explanations for the discrepancies are: 1) "...the yet-to-be-deduced relationship between the situation in which the information is presented for learning and the situation in which the learning is tested", and 2) an increase in intelligibility when subjects are permitted to observe the lips and facial movements of the speaker.⁷

In conclusion Hartman states that:

The accumulated evidence is not sufficient to allow generalization from the studies comparing the pictorial channel with the audio and print channels, but...the results tend to favour the pictorial. Further experimentation attempting to confirm this observation is necessary.⁸

It may be observed, also, that none of the studies compared all three different methods of presenting learning material.

More recently an article by Bourisseau, Davis and Yamamoto entitled, "Sense Impression Responses to Differing Pictorial and Verbal Stimuli", contends:

that pictures are indeed more effective than printed words in both the presentation of information and the evocation of sensory response is a conclusion supported more by faith than by facts.⁹

⁵ Ibid., p.239. ⁶ Ibid. ⁷ Ibid. ⁸ Ibid., p.241.

⁹ W. Bourisseau, O.L. Davis and K. Yamamoto, "Sense Impression

In this study on which the article is based thirty-five concrete nouns were presented in condition one as printed words, in condition two as line drawings, and in condition three as a combination of the printed word and pictorial line drawings. The subjects were instructed to respond with the first word that came to their minds. Additional directions to those in the picture condition suggested that they respond with a word other than the name of the picture. The evaluation scheme was restricted to the stimuli's physical attributes and did not include responses that were aesthetic, effective, or imaginative. The findings indicated that subjects gave more nonsensory responses than sense impression responses to the stimuli presented in all of the conditions. They also indicated that:

...a higher proportion of subjects gave no sense-impression response at all when the stimuli were presented in a picture format than when they were shown in either printed word or printed word and picture formats.¹⁰

In addition, the proportion of sense-impression responses was highest under the printed word mode, followed by the printed word and picture mode.

In conclusion the researchers state that since the pictorial stimuli were inferior to verbal stimuli in "...a) the number of subjects making sensory responses and b) the total number of sensory responses evoked",¹¹

Responses to Differential Pictorial and Verbal Stimuli", Audio Visual Communication Review, vol. 13 no. 3 (Fall, 1965) p.250.

¹⁰ Ibid., p.254. ¹¹ Ibid., p.255.

the idea that "A picture is worth a thousand words" must be carefully reconsidered as a meaningful guide to educational practice.

Single Channel and Paired Associate Tasks

In 1949, A.A. Lumsdaine completed his doctoral thesis in which he used a paired-associate type of learning task to compare the "functioning of pictures and printed words as associative cues and as response prompts."¹² Four kinds of paired-associates were used: picture-picture, picture-word, word-picture, and word-word. The subjects had to learn to name the response object of each pair. The results showed that the use of pictures to present the first object of the pair was better than verbal presentation, but that verbal presentation was definitely superior to pictorial presentation for the second (response) term of the pair.¹³

C.C. Wimer and W.E. Lambert of McGill University, in the article "The Differential Effects of Word and Object Stimuli on the Learning of Paired-Associates", describe their study in which nine nonsense syllables (acting as response items) were paired with: a) meaningful words, b) objects representing the meaningful words. They found that it required fewer trials to pair the nonsense syllables to the objects than to the words.¹⁴

A.A. Lumsdaine suggests that a pictured stimulus and a written response are the most efficient for presenting the stimulus and response members of paired-associates; and Wimer and Lambert, holding the response mode

¹² A.A. Lumsdaine, "Instruments and Media of Instruction," Handbook of Research on Teaching, American Educational Research Association, (Chicago: Rand McNally and Co.) 1963, pp.636-637.

¹³ Ibid.

¹⁴ C.C. Wimer and W.E. Lambert, "Differential Effects of Word and

constant, found that using the object rather than the word name for the object as a stimulus led to better results. There is some indication that the response half of the pair deserves more attention. B.J. Underwood and R.W. Schultz, in their book, Meaningfulness and Verbal Learning, state that it is the meaningfulness of the response that is most critical. They report that studies by Sheffield, Kimble and Dufort, Cieutat, Stockwell and Nobel, L'Abate, and Hunt all tend to agree that changes in meaningfulness of the stimulus are of little consequence to learning rate.¹⁵

Sex Differences

Sex differences with regard to effectiveness of learning and retention will be investigated in this study. L.E. Tyler states that almost all studies agree that females are better than males when it comes to memorizing and remembering most kinds of material.¹⁶ F.J. Boersma, R.Conklin, J.E. Carlson in their study of paired-associates found that females reached a criterion level of performance in significantly fewer trials than males.¹⁷

II. JUSTIFICATION FOR THIS STUDY

In the audio-visual field there is presently no well developed theoretical basis for the supposed superiority of any single channel of

"Object Stimuli on the Learning of Paired Associates" Journal of Experimental Psychology, (Vol. 57, no. 1, 1959) pp.31-36

¹⁵ B.J. Underwood and R.E. Schultz, Meaningfulness and Verbal Learning (Philadelphia: J.B. Lippincott Co., 1960), p.37.

¹⁶ L.E. Tyler, The Psychology of Individual Differences (New York: Appleton, Century Crofts, 1956), p.254.

¹⁷ F.J. Boersma, R.C. Conklin and J.E. Carlson, "Effects of

communication over another. As previously noted, W. Bourisseau, O. L. Davis and K. Yamamoto maintain that the argument for the superiority of pictures is supported more by faith than by fact;¹⁸ and Hartman maintains that there is not sufficient evidence to allow generalization from those studies comparing the pictorial channel with audio and print channels.¹⁹ Though there is some related research in psychology which could ultimately lead to a theoretical basis, at this time there is little one can say with confidence.

This study is therefore proposed as an exploratory project which would yield results of interest to persons in the field of education. It was further hoped that the results and information gained from this project might generate further research, on a more sophisticated level, which in turn could lead to a much needed theoretical rationale for the design and/or use of audio-visual media. The consideration of retention over an extended period of time is a major concern. Both the effort required to learn the tasks and the measured retention of the learning must be evaluated.

Reporting Associative Strategies", Psychon. Sci., vol. 5 no. 12, (1966), pp. 463-467.

¹⁸ W. Bourisseau, O.L. Davis, K. Yamamoto, op.cit., p.250.

¹⁹ F.R. Hartman, op. cit., p. 241.

Summary

There is little agreement among researchers as to which single channel of communication is the most effective in terms of efficiency of learning and retention. The studies as summarized by Hartman document the confusion. The confusion is the result of several factors:

1. There are not many studies.
2. The studies lacked proper controls.
3. The studies were not properly designed with regard to measurement and statistical treatment.
4. The pictorial channel was at a disadvantage in these studies because testing was always verbal.²⁰

The results, if they were valid, are not strictly comparable since:

1. The material to be learned in each study was different.
2. The subjects in each study were from different age groups.
3. The material in no one study, was presented by three different modes.

The consideration of retention over an extended period of time is a major concern. Both the effort required to learn the tasks and the measured retention of the learning must be evaluated.

²⁰ F.R. Hartman, op.cit., p.238.

²¹ Ibid., p.237.

CHAPTER III

SAMPLE, PROCEDURE, MATERIALS AND EQUIPMENT, AND STATISTICAL DESIGN

I. METHOD

Sample

The subjects for this study were one hundred and twenty grade eight boys and girls from the Edmonton Public School system. Grade eight was chosen as a result of a pilot study that explored the possibility of using either grade four or grade eight students. The grade eight students were chosen because of the inability of the grade four students to understand directional procedures and to handle more than five paired-associate learning tasks, especially in the verbal response mode.

The sampling procedure was begun by acquiring a list of all schools in the Edmonton Public School system having grade eight classrooms. The names of the schools were provided in rank order on the basis of grade nine SCAT results. The School Board employee who supplied the list indicated that a certain degree of stability relative to the SCAT scores was exhibited by schools over the years. The schools to be used in the study were then selected on the basis of their position on the list. The schools chosen were; one at the top, one at the bottom, and three in the middle.

Classrooms were selected randomly from the grade eight register rooms in each school. Class lists were acquired for each of the above register rooms, and four boys and four girls were randomly selected from

each list. The first six subjects chosen were the primary participants, and the spare subjects were selected in case any of the other subjects were absent initially or during the delay post-test time.

II. PROCEDURE

The modes of presenting the learning tasks were established on the basis of Table I and are as follows:

TABLE II

STIMULUS AND RESPONSE MODES FOR AUDIO-VISUAL PAIRED-ASSOCIATE LEARNING TASKS

		Stimulus			
		Visual		Audio	
		Verbal	Non-Verbal	Verbal	Non-Verbal
Response	Visual	Verbal	***		
		Non-Verbal	***		
	Audio	Verbal	***		
		Non-Verbal			

*** Defines Stimulus-Response Combination Used

The subjects were placed on the following treatment and post-test groups:

TABLE III

NUMBER OF STUDENTS AS ARRANGED IN TREATMENT AND POST-TEST GROUPS

Group	Immediately	Time		
		30 min.	48 hr.	7 days
Number of Students				
Treatment 1	10	10	10	10
Treatment 2	10	10	10	10
Treatment 3	10	10	10	10

In each school, each subject was brought, individually, to the testing room. Upon entering the room the subject was seated facing a projection surface at the distance of about five feet. Directly behind the subject was a table on which rested all the projection and sound equipment.

Treatment 1: The subject was given typewritten directions (appendix A1) and was asked to read them carefully. When the subject finished reading he was asked to observe the projection surface. All of the learning task slides (as defined on page six and illustrated in appendix C) were then shown on the left side of the screen, one at a time, at a fixed rate of one every five seconds.

There was a short pause (approximately five seconds) and then the stimulus half of one of the pairs appeared at the same location on the screen (page six, appendix C). All of the response words were flashed one at a time immediately to the right of the stimulus word at one second intervals. The subject responded by pressing a button when he saw the word he thought matched the stimulus word. Once a response had been made, or all the response slides had been shown, the next stimulus word appeared and again all of the next set of randomly ordered response slides were shown. If a subject did not make a selection during the showing of the ten response slides or if the wrong response was chosen, the recorder indicated an error on the score sheet, and the next stimulus slide was displayed. The subject picked the word he thought matched that stimulus word. This procedure was repeated for all stimulus words.

The learning task slides were again shown, one at a time, at a rate of one every five seconds. The subjects were then re-tested using each stimulus word followed by all ten response words. The subject again selected what he thought was the correct response to the stimulus word. Careful score was kept by the research assistant of every response, (see score sheet appendix D), and when a subject gave two successive correct responses to any stimulus, the learning task and stimulus slides of that pair were withdrawn. The subject was, in all cases, presented ten response slides. The pairs were presented until all were learned to the criterion of two successive correct responses. Once this had been accomplished those students not participating in immediate post-testing returned to class. Those slated for immediate post-testing were again presented the individual stimulus slides and a choice of all ten response slides. The other subjects were recalled for post-testing according to the delay time of the post-test group to which the subject had been assigned.

Treatment 2: The subject was given typewritten directions (appendix A2) and asked to read them carefully. When the subject finished, he was instructed to observe the projection surface. The learning task slides (as defined on page six and illustrated in appendix C) were then shown on the left side of the projection surface) one at a time, at a fixed rate of one every five seconds.

There was a short pause (approximately five seconds) and then a randomly selected stimulus half of one of the pairs appeared on the left

side of the screen. All of the response pictures were flashed on the screen, one at a time, at one second intervals immediately to the right of the stimulus slide. The subject responded by pressing a button when he saw the picture he thought matched the stimulus word. If a subject chose the wrong response slide, or did not make a selection during the showing of the ten response slides, the recorder indicated an error on the score sheet, and the next stimulus slide was displayed. Each stimulus word was shown individually along with all of the response pictures (in random order) and the subjects attempted to match the pairs.

The learning task slides were then shown again, one at a time, at a rate of one every five seconds. The subjects were tested using the same procedure as before. Careful score was kept of every response and when a subject gave two successive correct responses to any stimulus, the learning task and stimulus slides were removed from the test. The subject was presented ten response slides in all cases. The pairs were presented until all had been learned to the criterion of two successive correct responses. Once this had been accomplished those students not participating in immediate post-testing were returned to class. These other subjects were recalled for post-testing according to the delay time of the post-test group to which they had been assigned.

Treatment 3: The subjects were given typewritten directions (appendix A3) and asked to read them carefully. When the subject had finished, he was instructed to watch the projection surface while earphones were fitted to him. The learning task slides (as defined on page six and illustrated in appendix C) were shown at a fixed rate of one

every five seconds. During the five second exposure to the stimulus slide, the response half of the learning task was spoken into a microphone by the researcher. The response word was said only once, and the student used the remainder of the five seconds to make the required association. The subject saw the stimulus half of the pair on the projection surface and heard the response half of the pair over the ear phones. After all the learning tasks had been presented, there was a pause and then one of the stimulus words was projected on the screen. All of the response words were then presented by a pre-recorded tape through the ear phones. The subject responded by saying the word that he thought matched the stimulus word seen on the screen. The rest of the stimulus words were shown individually and in every case the subject heard all randomly ordered responses and attempted to match the pairs.

The same procedure was repeated from the start. Careful record was kept of all responses (appendix D), and if a subject gave two successive correct responses to any stimulus, it was removed from the learning and stimulus half of the testing slides. The learning tasks were presented and tested until all had been learned to a criterion of two successive correct responses. Once this had been accomplished, the students not in the immediate post-test group were returned to class. These subjects were recalled for post-testing according to the post-test group to which they had been assigned.

III. MATERIALS AND EQUIPMENT

The Learning Materials

1. Stimulus and Response Materials: Underwood and Schultz state that there are four basic arrangements possible when paired-associate tasks are created based on the meaningfulness of the stimulus or response halves of the pairs.¹ The suggested possibilities are High-High (H-H), High-Low (H-L), Low-High (L-H), and Low-Low (L-L). They indicate that the H-H format is the least difficult to learn and the L-L is the most difficult. They then state that the L-H is easier to learn than the H-L.

A significant part of this study was the students' ability to associate a response with a stimulus. Since the response category had to be either spoken, printed or pictured it was felt that as a basis for the definition of the response category a high-meaningfulness word would be required. The low-meaningfulness stimulus was chosen to encourage some degree of difficulty and thus spread the scores. Nobel's list of di-syllables² was the source of learning task words for the study.

The stimulus items were selected from this list on the basis of pronounceability and the response items were selected on the basis of an artist's ability to draw a picture of the referent of the word. The items used were as follows:

¹ Underwood and Schultz, op.cit., pp. 27-43.

² Ibid., pp.331

A	ZUMAP	QUARTER
B	BOLAP	CAPTAIN
C	GOKEN	INSECT
D	RENNET	WAGON
E	BODKIN	MALLET
F	SAGROLE	MONEY
G	MEARDON	ZEBRA
H	VOLVAP	JELLY
I	TAROP	KEEPER
J	ATTAR	JEWEL

2. Slide Sets: The black and white slides were made of the selected words and pictures (see appendix C). A constant size ratio was maintained in the photographic techniques. One set of the learning task slides for each of treatments one and two, and one set of the stimulus slides were produced. Eight duplicate sets of response items were produced for treatments one and two.

Presentation Equipment

1. 35mm. stacking slide projector: This projector was chosen to present the learning tasks and the stimulus slides since it allows the researcher to easily randomize (by shuffling the slides) the order of the slides between presentations, and to withdraw slides when the stimulus material was learned to the required criterion.

2. 35mm. Carousel Projector: This projector was selected as a testing projector, to present the response items.

Eight sets of ten response slides were placed in separate trays for treatments one and two. The slides were randomly arranged within each of the eight sets in the first tray, and this same random order was used in the second tray. The projector was equipped with a remote advance mechanism operated by the researcher. The projector was modified so that when the student pressed a button signifying his selection, the researcher could not advance the tray.

3. Tape Recorder and Head Sets: A regular audio tape recorder was used. It was "patched" to a junction box which allowed the use of two head sets. One head set was worn by the subject and the other by the researcher. In this way, the researcher knew if the subject had heard the choices once and could control the advance of the next stimulus test slide. The taped multiple choice test was made by the researcher. The items were arranged in exactly the same order as the slides in the treatment one and two test trays. The items were said at one second intervals and a four second pause was provided between complete sets of ten response items.

IV. STATISTICAL DESIGN

The analysis of variance technique was chosen as the statistical means for data analysis for several reasons. First, the possible significance of mean differences can be analyzed simultaneously by an overall test of significance without doing "t" tests between every possible pair of means. In the case of a two-or-three-way analysis of variance the effects of different factors of the criterion variable can be calculated. Also

this design permits a significance test for the possible interactions of the effects of the factors of the dependent variable.

The specific design which lends itself most naturally to the analysis of this data is a p x q x r complete factorial with equal observations per cell.³ For the present study the factors were:

Factor p (A) -- Sex

Factor q (B) -- Treatment (group membership)

Factor r (C) -- Delay (post-test group membership)

Dependent variable hypothesis I: Total number of errors

Dependent variable hypothesis II: Score on post-test.

TABLE IV

CELL ARRANGEMENT FOR THREE-WAY ANALYSIS OF VARIANCE

	Treatment 1				Treatment 2				Treatment 3			
	1	2	3	4	1	2	3	4	1	2	3	4
Male												
Female												

1 = Immediate post-test 2 = 30 Minute post-test
 3 = 48 Hour post-test 4 = 7 Day post-test

Both hypotheses one and two used the same cellular arrangements shown above. The only difference was the criterion measure used in each case. For hypothesis I the total number of errors to criterion was used, and for hypothesis II score on delayed post-test was the dependent variable.

³ Winer, B.J., Statistical Principles in Experimental Design, New York: McGraw-Hill Book Co., 1962, p.248.

CHAPTER IV

RESULTS AND CONCLUSIONS

I. RESULTS

Hypothesis I

The three-way analysis of variance technique (or $p \times q \times r'$) indicates significant main effects and interaction effects.

The hypothesis tested here was that there is no significant difference in the number of errors a subject makes in reaching the learning criterion as a result of sex, treatment group, or post-test group membership.

TABLE V

THREE-WAY ANALYSIS OF VARIANCE WITH ERRORS TO CRITERION AS THE CRITERION MEASURE

Source	SS	MS	df	F
A (sex)	2.4083	2.4083	1	0.0237
B (mode)	3489.3502	1744.6751	2	17.1600
C (delay)	252.6918	84.2306	3	0.8285
AB	82.5171	41.2585	2	0.4058
AC	503.5587	167.8529	3	1.5509
BC	903.3838	150.5640	6	1.4809
ABC	1143.0167	190.5028	6	1.8737
Error	<u>9760.3992</u>	101.6708	<u>96</u>	
Total	16137.3258		119	

p (.05) df 2,96 F = 3.09
p (.01) df 2,96 F = 4.82

The F ratios obtained for main effect A (sex) and main effect C (placement in post-test group) indicate that the null hypothesis, as stated for these variables must be accepted. The F ratio for main effect B (placement in treatment group), however, is highly significant ($p < .01$) and, therefore, the null hypothesis relative to this variable is rejected and its alternate accepted. This is to say, there was a significant difference in the number of errors the treatment groups made in reaching the learning criterion. This would seem to be a result of the mode of presentation. The non-significant F value for factor A (sex) indicates that, at least for the learning materials presented, there was no significant difference in ability to learn these tasks in the selected sample. There was also a non-significant F value for factor C (placement in post-test group). This is very important since it indicates that subjects assigned to all post-test cells were similar in their ability to learn the tasks. The findings regarding hypothesis II will be strengthened by this knowledge.

There was some indication that the data did not meet the assumption of homogeneity of variance. In order to test the assumption the following test of homogeneity of variance was performed.

TABLE VI
TREATMENT MEANS, AND STANDARD DEVIATIONS
OF ERRORS TO CRITERION

	T ₁	T ₂	T ₃
Mean	20.45	9.85	21.975
Standard Dev.	13.75	4.26	10.44

An F max test (as described in Winer) on the above information yields the F max ratio of 10.418. The required ratio for significance at the .05 level is 5.34 ($k = 3$ df = 9) and 85 for the .01 level.¹

This result indicates that the assumption was not in fact met. The standard deviations were, however, linearly related to their means. Lindquist suggests, "In this case, if the logarithm of X or of (X+1) is substituted for X as the criterion measure, it may be found that the variances of the transformed measures are much more homogeneous than those of the original measures, and that the transformed distributions are much more normal as well."²

Table VII illustrates the effect of the transformation on the means and variances.

TABLE VII

COMPARISON OF ORIGINAL MEANS AND STANDARD DEVIATIONS
WITH TRANSFORMED MEANS AND STANDARD DEVIATIONS

	Treatment 1		Treatment 2		Treatment 3	
	Raw	Trans.	Raw	Trans.	Raw	Trans.
Means	21.97	3.03	9.85	2.3	20.45	2.88
Standard Deviation	10.44	0.47	4.26	0.44	13.75	0.63

The F max test on the transformed data yielded a ration of 2.05. This ratio was less than the 5.34 required to be significantly different at the .05 level. The variances were now more homogeneous and the analysis of the data was continued.

¹ Winer, op.cit. pp. 92-93.

² E.F. Lindquist, Design and Analysis of Experiments in Psychology and Education, (Boston: Houghton Mifflin Co., 1953) p. 88.

Since there was only one significant main effect and no interaction effects recorded in the foregoing analysis, it was decided to transform the data and use a one-way analysis of variance. The following is the result of the transformation:

TABLE VIII

ONE-WAY ANALYSIS OF VARIANCE USING AN
A LOG TRANSFORMATION ON ERRORS
TO CRITERION AS CRITERION

Source	SS	MS	df	F
Mode	12.04335	6.021625	2	21.79 p<.001
Errors	32.33411	0.27635	117	

The F ratio was highly significant, (see also appendix E) and t-tests were employed to locate the exact areas of significance. The following table indicates the results of these t-tests:

TABLE IX

RESULTS OF t-TESTS ON TRANSFORMED
DATA USING ERRORS TO
CRITERION

Means	t	p
T ₁ -T ₂	4.719	<0.00001
T ₁ -T ₃	1.242	0.21792
T ₂ -T ₃	7.180	<0.00001

df = 78

It can be seen that subjects in treatment 2 (visual-non-verbal) scored significantly better than subjects in either treatments 1 or 3,

(Visual-verbal and auditory-verbal respectively), and that scores made by subjects in treatments 1 and 3 do not differ significantly. This means that hypotheses 1A and 1C were accepted and that hypothesis 1B was rejected.

Hypothesis II

A three-way analysis of variance was used to analyze this data. The hypothesis tested here was that no significant differences in the amount of retention would be exhibited over a period of time associated with sex, mode of presentation, or amount of time passing before delay post-testing. The following table illustrates the results of the analysis:

TABLE X

THREE-WAY ANALYSIS OF VARIANCE USING
SCORE ON DELAYED POST-TEST AS
THE CRITERION MEASURE

Source	SS	MS	df	F
A (sex)	0.6750	0.6750	1	0.2769
B (mode)	40.2167	20.1083	2	5.2686
C (delay)	76.2917	25.4306	3	6.6630
AB	3.3500	1.6750	2	0.4389
AC	1.8917	0.6306	3	0.1652
BC	12.1833	2.0306	6	0.5320
ABC	7.5833	1.2639	6	0.3312
Error	<u>366.4000</u>	3.8167	<u>96</u>	
Total	508.5917		119	

df	2,96	F = 3.09
p .05	3,96	F = 2.70
	df	2,96 F = 4.82
p .01	3,96	F = 3.98

As may be seen in the Table X , there were two significant F ratios reported in this analysis.

Variable A did not yield a significant F ratio. Boys and girls did not differ significantly in their ability to remember this learning material.

Variable B (treatment groups) was significant beyond the .01 level. This indicates that score on delayed post-test was a function of membership in one or more specific treatment groups. Hypothesis II B is therefore rejected and its alternate, that there is a significant difference in post-test score as a result of the treatment effect, is accepted.

Variable C (delay-post-test group) was also significant. This indicates that as time increased between learning to criterion and post-testing score changed significantly.

The relatively high negative correlation between errors to criterion and score on delay post-test ($r = -.565$) coupled with the highly significant treatment effect, led this researcher to repeat the three-way analysis of variance but now covarying the errors to criterion. The following illustrates the effect:

TABLE XI
THREE-WAY ANALYSIS OF CO-VARIANCE
USING SCORE ON POST-TEST AS CRITERION MEASURE

Source	SS	MS	df	F
A (sex)	0.4642	0.4642	1	0.1646
B (mode)	3.4248	1.7124	2	0.6071
C (delay)	52.4235	17.4745	3	6.1952
AB	0.9436	0.4718	2	0.1673
AC	5.9521	1.9840	3	0.7034
BC	9.5783	1.5964	6	0.5660
ABC	5.9067	0.9844	6	0.3490
Error	<u>267.9623</u>	2.8207	<u>96</u>	
Total	346.1181		118	

To be significant at the .01 level with 3,96 degrees of freedom, an F ratio would have to be 3.98. The significant F ratio for variable C ($p < .01$) indicates that there are differences in delay post-test results. Neither variable A or B yielded a significant F ratio in this analysis. Hypotheses II, A and B are therefore accepted and hypothesis C is rejected. The graph of mean post-test scores is as follows:

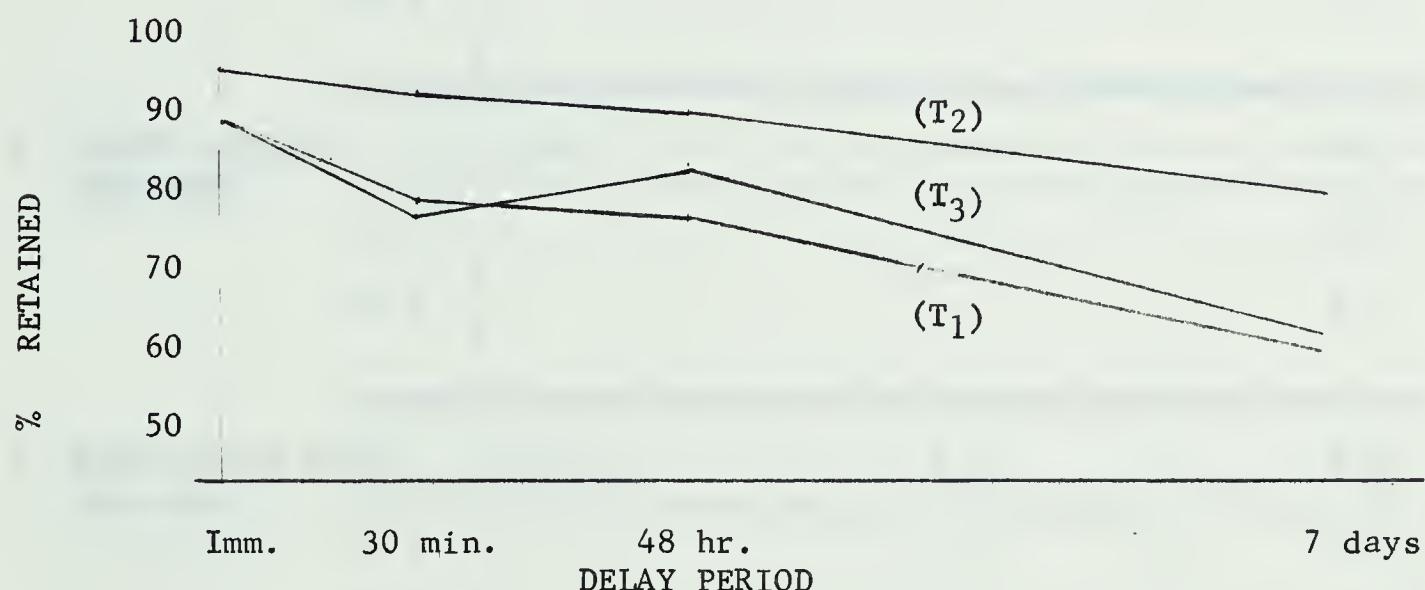


FIGURE I

GRAPH OF WITH-IN CELL MEAN SCORES USING
DELAY TEST RESULTS

The Newman-Keuls tests on the above mean scores yielded the following results:³

³ Winer, op.cit., pp.238-239.

TABLE XII
RESULTS OF NEWMAN-KEULS TESTS
USING POST-TEST SCORES (BETWEEN TREATMENTS)

	Ordered Means		
A. IMMEDIATE POST-TEST	8.9	8.9	9.4
	8.9	-	.5
	8.9	-	.5
B. THIRTY MINUTE POST-TEST	7.8	7.9	9.2
	7.8	-	1.4
	7.9	-	1.3
C. FORTY-EIGHT HOUR POST-TEST	7.7	8.4	8.9
	7.7	-	1.2
	8.4	-	.5
D. SEVEN DAY POST-TEST	6.0	6.3	8.3
	6.0	-	2.3 **
	6.3	-	2.0 **

$$df = p \times q \times r \times (n-1) = 216 \quad S_{\bar{x}} = .535$$

	Steps 1	2
q.95 (r 216)	1.48	1.87 (*)
q.99	1.95	2.20 (**)

TABLE XIII

RESULTS OF NEWMAN-KEULS TESTS USING
POST-TEST SCORES - (WITHIN TREATMENTS)

A. TREATMENT 1	6.0	7.7	7.9	8.9
6.0	-	1.7*	1.9*	2.9**
7.7		-	.2	1.2
7.9			-	1.0

B. TREATMENT 2	8.3	8.9	9.2	9.4
8.3	-	.6	.9	1.1
8.9		-	.3	.5
9.2			-	.2

C. TREATMENT 3	6.3	7.8	8.4	8.9
6.3	-	1.5*	2.1*	2.6**
7.8		-	.4	1.1
8.4			-	.5

$$df = p \times q \times r \times (n-1) = 216 \quad S_{\bar{x}} = .535$$

steps	1	2	3
q.95 (r 216)	1.4	1.87	1.94(*)
q.99	1.95	2.20	2.35(**)

Discussion of Results from Table XII

1. Immediate post-test yielded no significant difference between treatments.
2. Thirty minutes later there was no significant difference between treatment scores.
3. There was no significant differences at forty-eight hours.
4. Retention using the visual-non-verbal mode was significantly higher than either the auditory-verbal or the visual-verbal modes after a delay period of seven days.

Discussion of Results of Table XIII

Treatment 1. The results indicate that score after seven days is significantly different from the scores at each of the other post-test periods. The drop in score after seven days is significant beyond the .01 level.

Treatment 2. These results indicate that at no time within the seven days did the scores differ significantly. This is an important finding in that it shows the relative permanence of the learning when presented by visual-non-verbal means.

Treatment 3. These results indicate that score after seven days is significantly different from the scores at each of the other post-test periods. The drop in score after seven days is significant beyond the .01 level.

II CONCLUSIONS

Hypothesis I.

Students who were presented with the task of associating a low-meaningfulness English word with a picture (T_2) were able to make the necessary associations with significantly fewer errors to criterion than were students who were required to match the same low-meaningfulness word with either the printed or spoken (T_1 and T_3) abstraction of the aforementioned picture.

Hypothesis II.

The students who learned to associate the words with pictures (T_2) scored significantly higher than the students who learned to associate the words with the printed words (T_1) on delayed post-tests seven days later. The picture group (T_2) scored significantly higher than the group that was given the printed low-meaningfulness word linked with the auditory-verbal word (T_3) when each was tested after a delay period of seven days.

After a period of seven days scores for treatments 1 and 3 had fallen significantly. In both treatments final score was significantly different from scores on tests at every other delay test time. Treatment 2 however, showed no scores significantly different from any other scores. The material learned was "retained" over the seven day period.

Summary

The results of this study indicate that subjects in treatment 2 (picture response mode) learned to associate printed stimulus material with pictures with significantly fewer errors to a specified learning criterion than subjects in treatments 1 or 3 who were asked to associate the printed stimulus material with printed and spoken response material respectively.

A further finding is that after a period of seven days treatment 2 subjects scored significantly better on a test of retention, and that while delay scores in treatments 1 and 3 dropped significantly over the seven day period, treatment 2 scores did not differ significantly.

CHAPTER V

DISCUSSION AND IMPLICATIONS

I. DISCUSSION

Hypothesis I.

The conclusion for hypothesis I, as stated in Chapter IV was that the subjects who were taught and tested with a visual non-verbal response mode scored significantly fewer errors in reaching the prescribed learning criterion than did subjects who were taught and tested with either the visual-verbal or the auditory-verbal response modes. It should be recalled that the visual-verbal stimulus was utilized in all treatment groups. In both the visual-verbal (T_1) and auditory-verbal (T_3) response modes the "verbal" characteristic was constant.

The two treatment groups response modes did differ however, since T_1 had a visual response mode and T_3 had an auditory response mode. Despite the fact that T_1 was visual and T_3 was auditory there was no significant difference in the number of errors subjects in these treatment groups made in reaching the learning criterion. The visual aspect in this comparison did not seem to benefit subjects who were in treatment group 1.

The visual-non-verbal (T_2) group differed significantly from both the visual-verbal and the auditory verbal response modes. In this instance the "visual" aspect was constant in T_1 and T_2 yet the groups differed significantly in the number of errors they made in reaching the learning criterion. Treatment groups 2 and 3 differed both in visual versus audio and non-verbal versus verbal, and the difference in the number of errors made in reaching learning criterion was highly significant. These findings would

tend to indicate that the differences are not a function of visual versus auditory, but are a function of verbal versus non-verbal.

Reference is made to this verbal/non-verbal quality of signs by J.Q. Knowlton.¹ He suggests that this continuum is one of digital and iconic with the verbal at the digital pole and non-verbal at the iconic pole. He further suggests that iconic signs should be learned more readily than digital signs.

Mark A. May in like manner suggests iconic representations at one pole and symbolic representations at the other pole of a similar continuum.² J.J. Gibson presents another continuum of convention-projection.³ He places linguistics at the convention pole and pictures at the projection pole. Each of these representations suggests a verbal-non-verbal continuum, not a visual-auditory dichotomy.

One other factor that might be considered in relation to the results of hypothesis I was suggested by E.J. Gibson in one of her earlier papers where she explored the effects of intra-list generalization.⁴ The specific factors of similarity or homogeneity of items was discussed in terms of discriminability or "the establishment of differentiation between items or units of a task."⁵

¹ J.Q. Knowlton, "The Need for a Conceptual Rationale For the Audio-Visual Field", New Directions in Audio-Visual Communication, Bulletin of the School of Education, Indiana University, Vol. 36, No. 6 (November, 1960) p.59.

² Mark A. May, Ward-Picture Relationships in Audio-Visual Presentations, U.S. Department of Health, Education and Welfare - Office of Education (July 20, 1965) p.2.

³ J.J. Gibson, "A Theory of Pictorial Perception", Audio-Visual

She is quoted as suggesting that "Generalization is, ... a function of similarity."⁶ and that:

To the extent that generalization favors incorrect responses, i.e., when similar items require different responses, learning is delayed. To the extent that generalization favors correct responses, i.e. when similar items require the same response, learning is facilitated.⁷

Leo Postman and D.A. Riley in this regard, state that "... there will be more generalization between two syllable cue and a number or design cue."⁸ In support of this concept Winer and Lambert state that:

generalization among stimuli and response is greater for a list of word-syllable pairs, i.e. that the necessary discrimination between stimulus and response is more difficult when both are verbal items.⁹

They also state that "the physical similarity among objects appears to be much less than among object names ..." ¹⁰

These concepts are all relevant to the results obtained in hypothesis I. since the materials utilized in the response modes were verbal and non-verbal and since they very likely varied in degree of intra-list generalization.

Hypothesis II

The fact that there was no significant difference on post-test scores immediately after the last item was learned to criterion implies

Communication Review, Vol. 2 No. 1 (1954) pp. 11 - 12.

⁴ E.J. Gibson, "Intra-List Generalization as a Factor in Verbal Learning", Journal of Experimental Psychology, Vol. 30, No. 3 (March, 1942) P.185.

⁵ Ibid.

⁶ L. Postman and D.A. Riley, "A Critique of Kohler's Theory of

that the materials, no matter how taught, were learned to the same extent. After a delay period of seven days retention of the material taught by the visual non-verbal mode was significantly better than retention of material presented by either of the other two verbal modes. In addition, retention scores over the seven day period within treatment 2 did not differ significantly, while scores in treatments 1 and 3 after seven days, differed significantly from all other delay scores within the respective treatment group. This finding would tend to substantiate E. Dale's contention that audio-visual materials tend to make learning "more permanent."¹¹

The results of this study must be considered in the light of several compromises that were made in order to make this study "manageable." The first consideration grows out of the third limitation of this study. Intelligence, achievement rating, socio-economic status and motivation level were not selected as factors to be controlled at this time. A second consideration was that six students from each classroom, and four classrooms per school were used in selecting the sample. It is possible that there may have been some interaction between some of the forty-eight hour and seven day delayed post-test subjects. This researcher did not attempt to establish the extent of possible interaction.

Association", Psychological Review, Vol. 64 No. 1, (1957) p.64.

7 Ibid. 8 Ibid.

9 C.C. Wimer and W.E. Lambert, "The Differential Effects of Word-and Object Stimuli on the Learning of Paired Associates", Journal of Experimental Psychology, Vol. 57, No. 1 (1959) p.35.

10 Ibid.

11 E. Dale, Audio Visual Methods in Teaching (Rev.), New York: Holt, Rinehart and Winston, 1963, p.66.

A third consideration centers around the presentation of the materials. While all possible caution was taken to control the presentation time, it may have been better if the slide change mechanisms in both slide projectors had been controlled by a timing mechanism. This could have meant a more uniform exposure rate for the learning and testing materials.

II. IMPLICATIONS

For Further Research and Educational Practice

1. This study could be replicated with other grade levels to establish evidence of the effect of age on the efficiency of these materials in teaching the selected information. It is generally thought that more "concrete" materials may be more important at some age or grade levels than at others.¹² Further study in this area may yield information concerning the validity of this thought.

2. This study could be replicated but with the researcher obtaining more demographic information on each of the subjects and controlling those factors. This kind of study might give researchers a knowledge of the kinds of factors that may be significant, and therefore should be controlled in studies of this nature.

3. This study might be replicated with emphasis placed on controlling the generalizability of the picture and/or print response items.

4. Further studies may be carried out to explore sex differences in the picture, print or spoken word response modes individually.

¹² J.Q. Knowlton, op.cit., pp.58-59.

5. It would be of some value to explore the effect of varying the iconicity of the picture response mode. This would yield valuable information regarding the amount of detail and/or color that should be used in creating visual teaching materials.

6. This study might be replicated with the total learning time to criterion as the major factor in the analysis. Efficiency should include the amount of time required for the subject to learn the material to the desired learning criterion.

7. This study might be replicated asking the students to report how they remembered the way the words or pictures "went with" the stimuli. The analysis of these strategies may yield information as to why the pictures were learned with fewer errors and why they were better retained after the seven day period.

8. A study to determine the effect of word-picture links could be done in the area of beginning reading. A set of visuals could be designed around the basic knowledge of reading theorists, and a controlled study done to indicate the effects on this subject matter at a very early age.

9. Parts of introductory courses in biology, science and mathematics could be taught in much the same way as number 8 above, and the results compared with control groups taught the traditional way.

For Theory

A study like this might be of some use in verifying or modifying the following model which grew out of the search for a theoretical basis for this study:

1. Take the universe of nouns and place them on an abstract-concrete continuum.



FIGURE 2

ABSTRACT-CONCRETE CONTINUUM

2. Use this line to represent all printed nouns and add a line above and below to represent the spoken-word and pictures respectively.

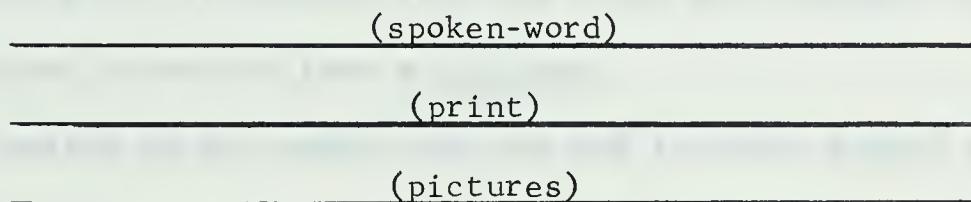


FIGURE 3

DIGITAL-ICONIC DIMENSION

These represent a second dimension of the abstract-concrete (or the digital-iconic) relationship in that a picture of a car should be more concrete than the printed word "CAR". The three levels represented so far are those explored in the present study. To develop the model further though, there might be additional abstract levels and concrete levels such as those shown appended below.

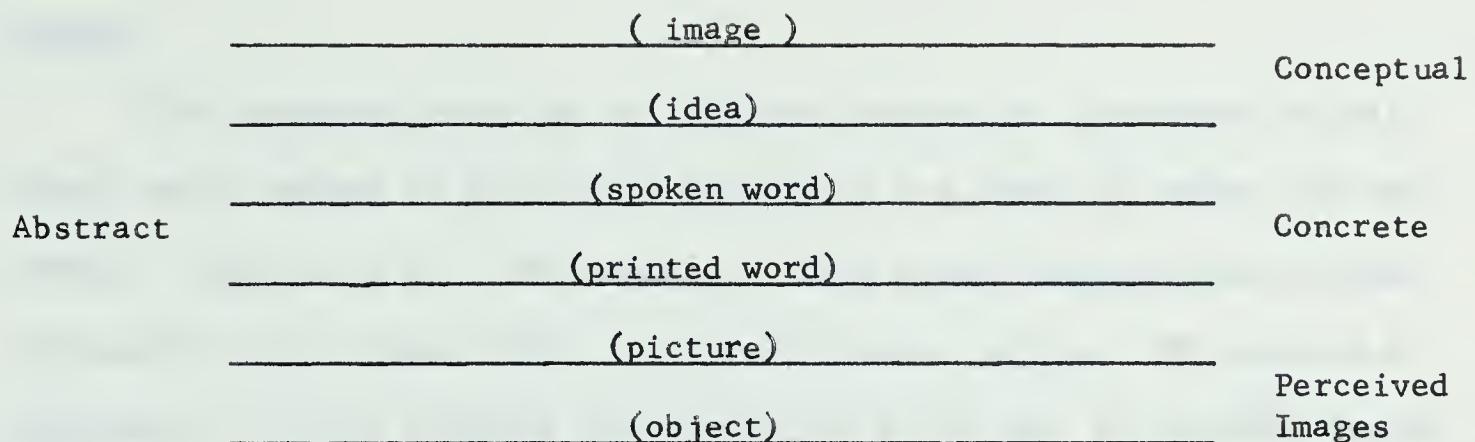


FIGURE 4

PROPOSED MODEL

At this point it appears that the "top" and "bottom" of the model might be wrapped around to form a cylinder.

3. Looking at the model from the end it would appear as follows:

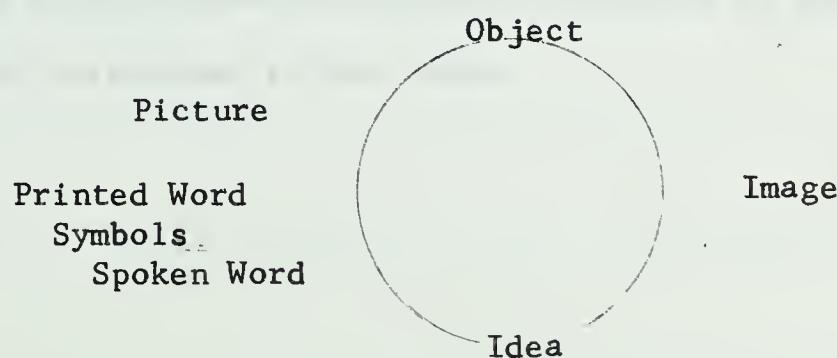


FIGURE 5

END VIEW OF MODEL

The further development or validation of this model might grow out of several studies related to this one.

Summary

The characteristics of the learning materials, presented in this study, which appear to be of some importance are those of verbal and non-verbal. That is to say, the results of this study indicate that no generalization can be made about the visual channel per se. The results of hypothesis II would indicate that retention score over an extended period of time, in this study a seven day period, was superior for the subjects who were taught and tested using the visual non-verbal response mode.

An explanation for the findings of this study is not presently available in existing literature. There is considerable interest in studying the overall issues identified in this thesis, but because of the complexities of this problem few pertinent studies have been reported. In order to develop a theoretical rationale, applicable to media in general, more research is required in this area.

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APPENDICES

APPENDIX A

Instructions to Subjects In Treatment Groups 1, 2 and 3

No. 1

Directions for students in treatment one

You are about to see a number of pairs of printed words. The pairs will be shown to you one at a time, and will appear on one side of the

screen. Here is an example that will not be on the list

ULNA FLOWER

You will see several such pairs and must try to remember which words appear together. After you have seen all the pairs, the first word of each pair

will appear again. In the example you would see

ULNA All of

the second words from each of the original pairs will then be shown, one at a time, on the other half of the screen. When you see the word that

appeared with ULNA (in this case)

FLOWER press the button

and hold it for a few seconds. The same thing will happen for each of the first words of the pairs.

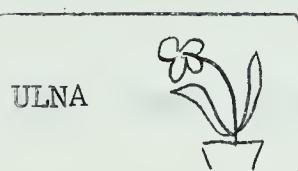
The pairs will then be re-shown and again you will be tested. When you have learned any pair it will be removed from the test. This sequence will be repeated until you have learned all the pairs.

If you are not sure of what is going to happen, please read these directions again.

No. 2

Directions for students in treatment two

You are about to see a number of pairs of printed words and picture combinations. The pairs will be shown to you one at a time, and will appear on one side of the screen. Here is an example that will not be on the list:



You will see several such pairs and must try to remember

which printed word and picture go together. After you have seen all the pairs, the printed word of each pair will appear again. In the example you

would see



All of the pictures will then be shown, one at a time, on the other half of the screen. When you see the picture that

appeared with ULNA



press the button and hold it for a few sec-

onds. The same thing will happen for each of the other words.

The pairs will then be re-shown and again you will be tested. When you have learned any pair it will be removed from the list. This sequence will be repeated until you have learned all the pairs.

If you are not sure of what is going to happen, please read these directions again.

No. 3

Directions for students in treatment three

You are about to be given a list of printed words paired with spoken words. The pairs will be given one at a time with the printed word appearing on one side of the screen and the spoken word coming to you through the head-

set. Here is an example that will not be on the list:

ULNA

FLOWER

(spoken). You will be given several such pairs and must try to remember which printed and spoken words go together. After you have been given all the pairs, the printed word of each pair will appear again. In the example you would

see

ULNA

All of the second words will then be said to you through

the headsets. When you hear the word that was given with

ULNA

(in this

case the spoken word FLOWER), say flower out loud. The same thing will happen for each of the other printed words of the list.

The pairs will be given to you again and you will be re-tested. When you have learned any pair it will be removed from the test. This sequence will be repeated until you have learned all the pairs.

If you are not sure of what is going to happen, please read these directions again.

APPENDIX B

**School, Classroom and Student Placement
on Treatment and Post-Test Schedule**

STUDENT PLACEMENT AND POST-TEST

SCHEDULE

No.	Level	Room									
2	high M(1)	1	2	high M(1)	2	2	high M(1)	3	2	high M(1)	4
6	M(2)	1	6	M(2)	2	6	M(2)	3	6	M(2)	4
	M(3)	1		M(3)	2		M(3)	3		M(3)	4
2	low	1	2	low	2	2	low	3	2	low	4
2	high M(1)	4	2	high M(1)	1	2	high M(1)	2	2	high M(1)	3
6	M(2)	4	6	M(2)	1	6	M(2)	2	6	M(2)	3
	M(3)	4		M(3)	1		M(3)	2		M(3)	3
2	low	4	2	low	1	2	low	2	2	low	3
2	high M(1)	3	2	high M(1)	4	2	high M(1)	1	2	high M(1)	2
6	M(2)	3	6	M(2)	4	6	M(2)	1	6	M(2)	2
	M(3)	3		M(3)	4		M(3)	1		M(3)	2
2	low	3	2	low	4	2	low	1	2	low	2

Number refers to the number of students from each level.

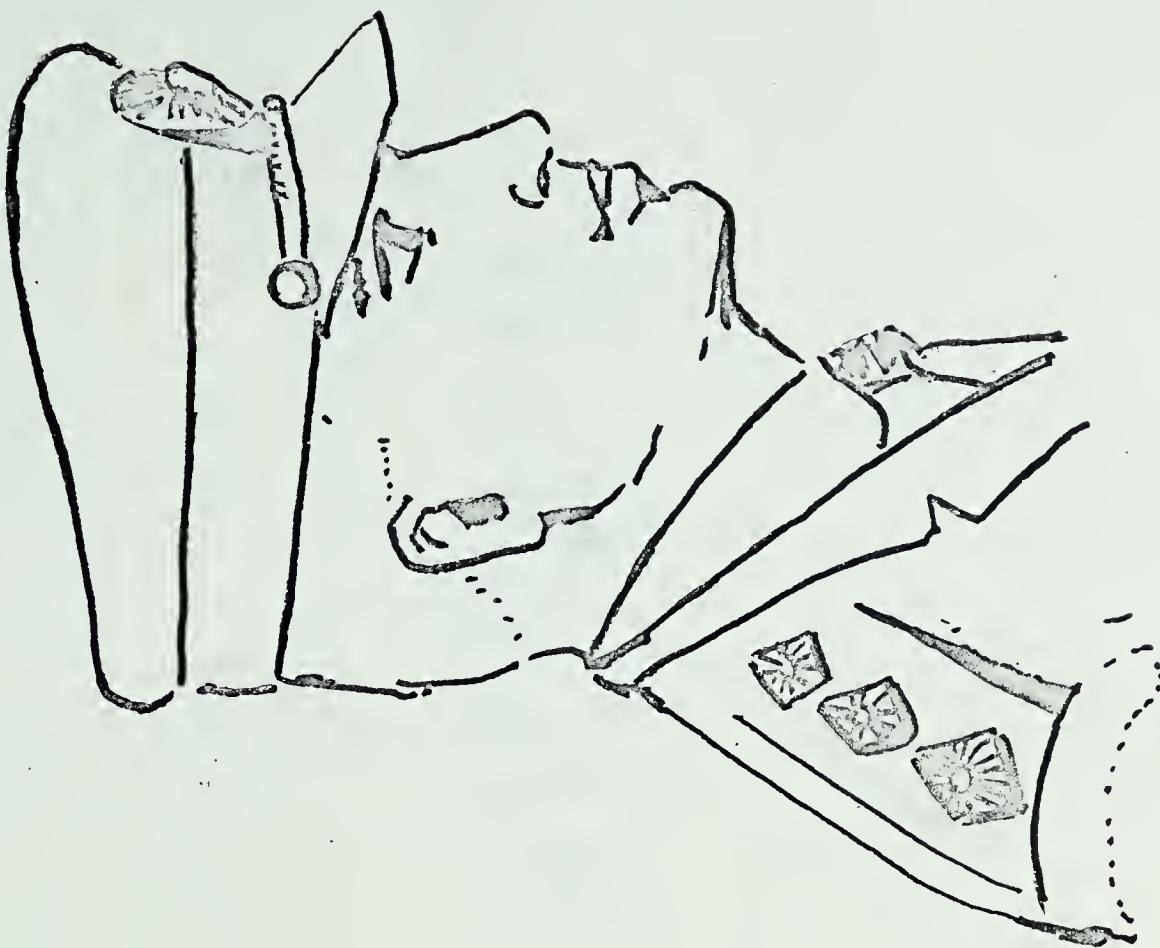
Level refers to the school's position on 1965 SCAT.

Room refers to order the four rooms were randomly selected in each school.

APPENDIX C

Sample Learning and Post-Test Materials

Includes complete set of visual-verbal and visual non-verbal stimulus-response material for the paired-associate (Bolap-Captain) and visual non-verbal response items for all other paired-associates in the study.

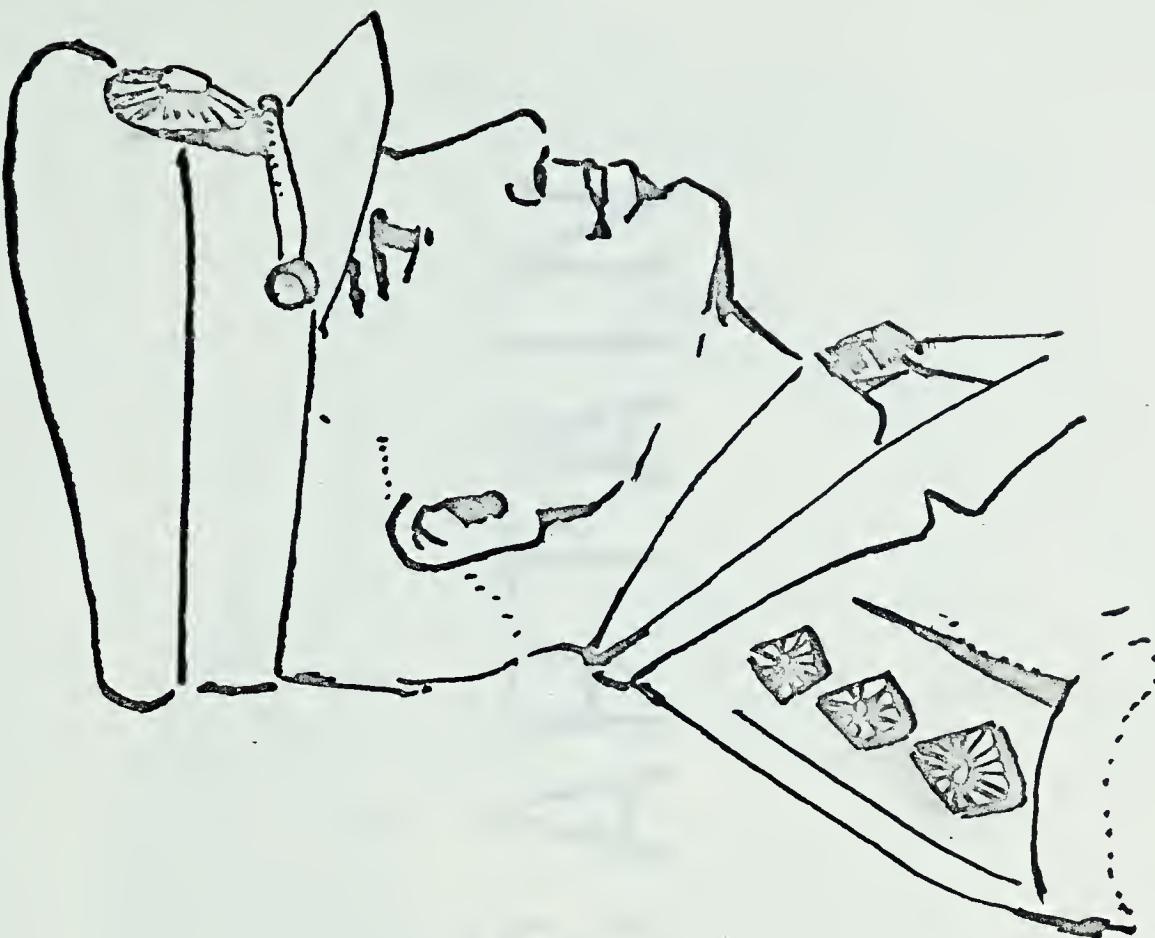


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L
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B

BOLAP

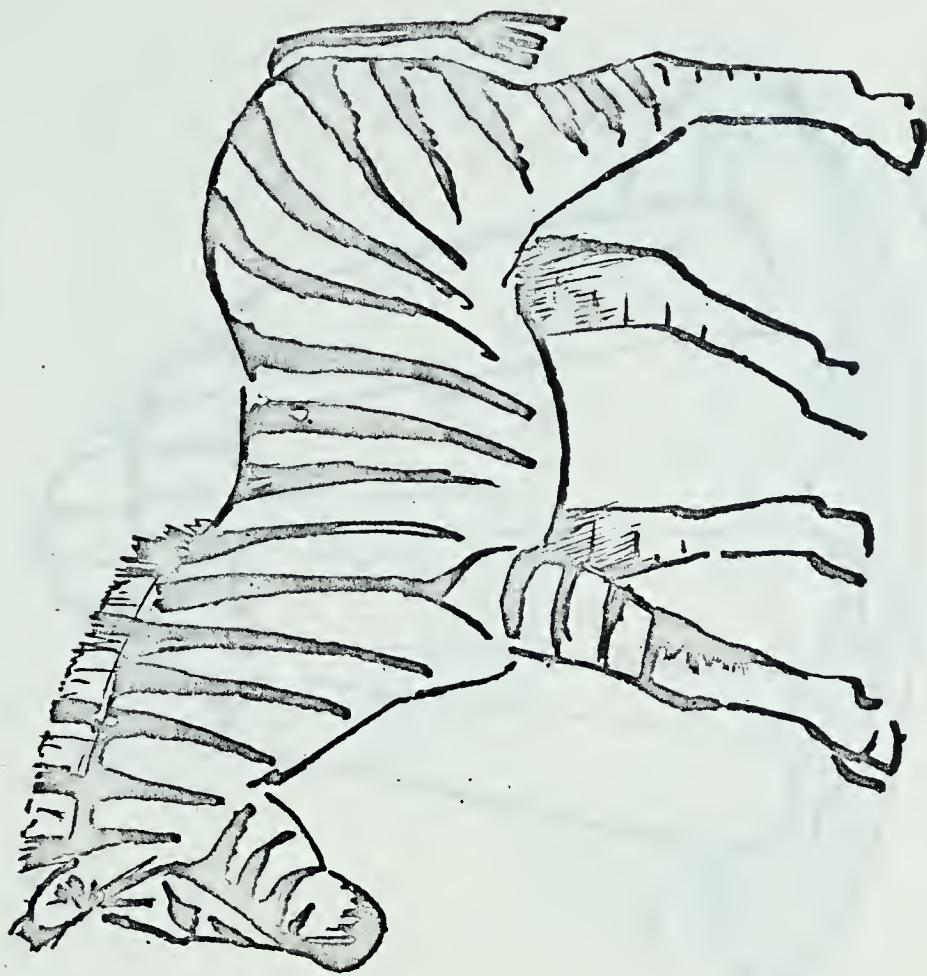
GATAN

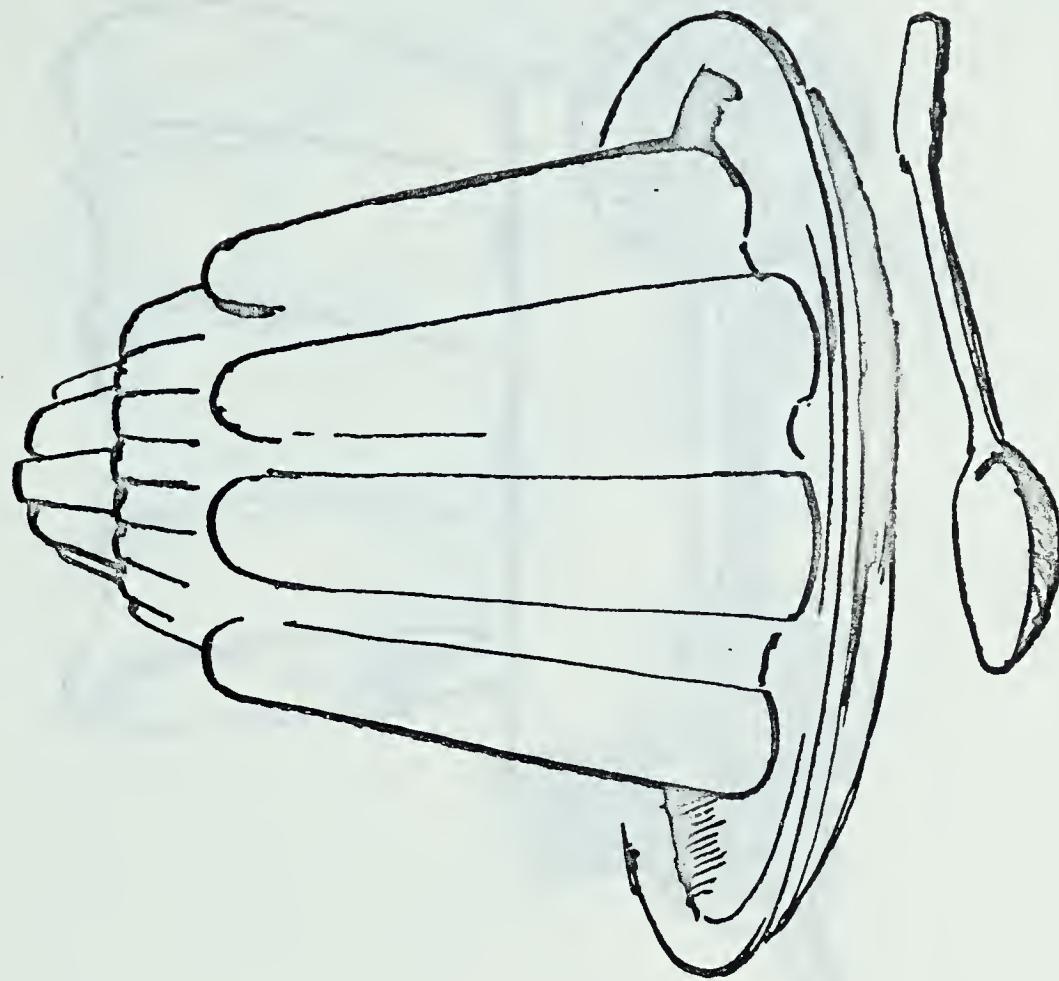
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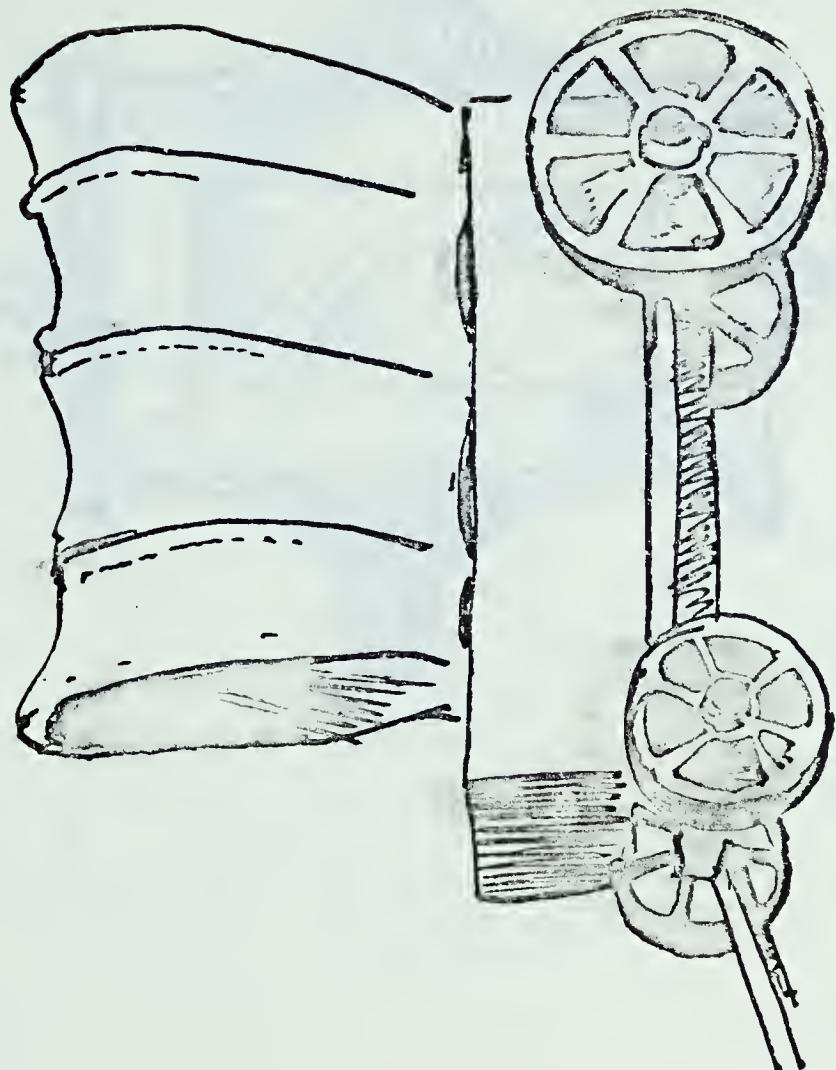


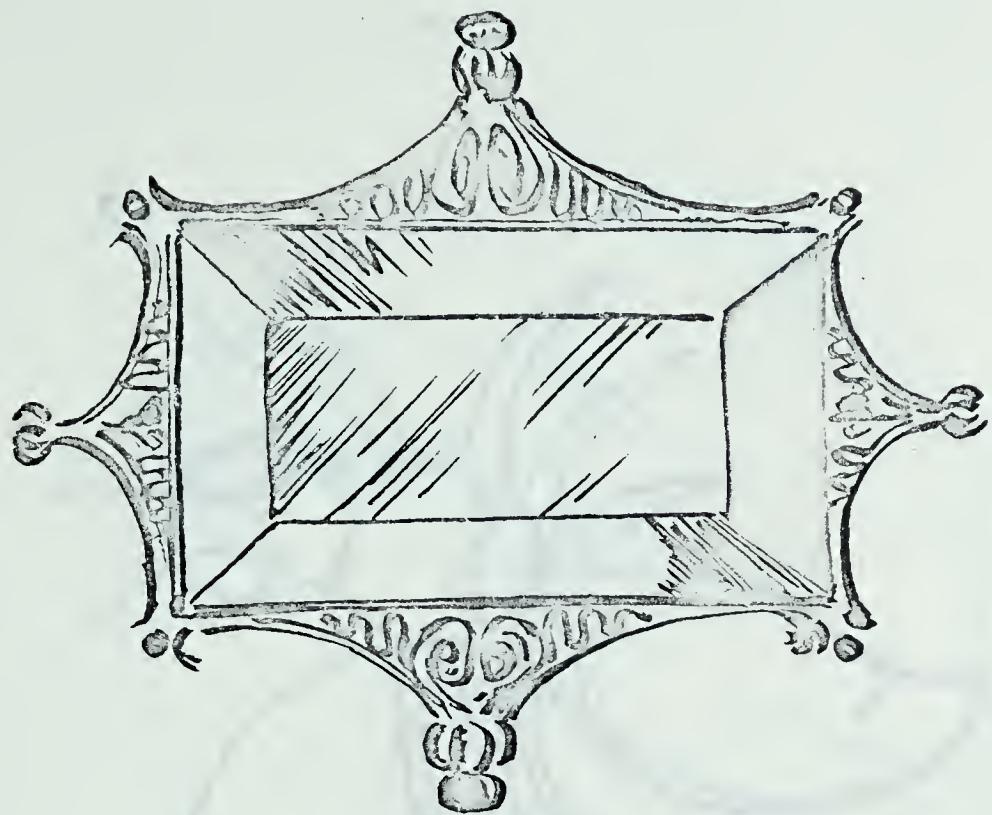
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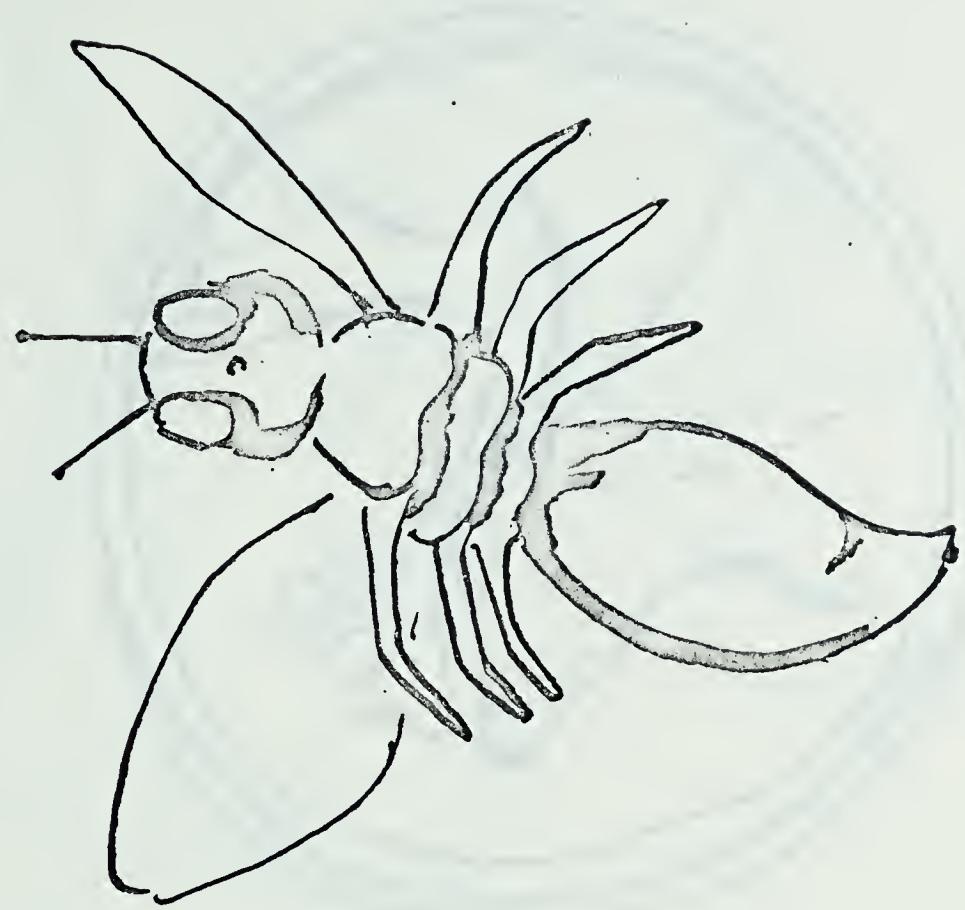
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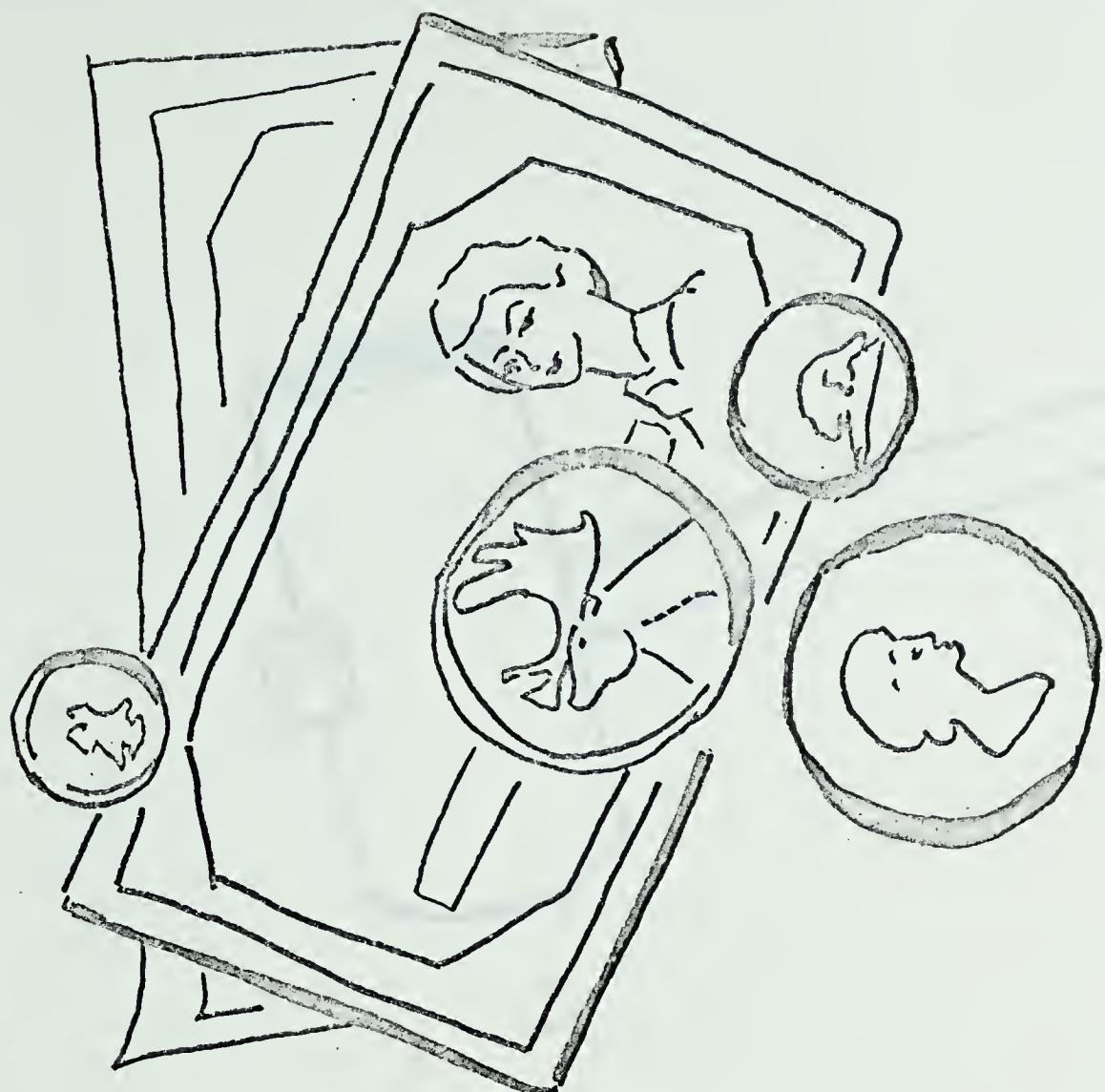


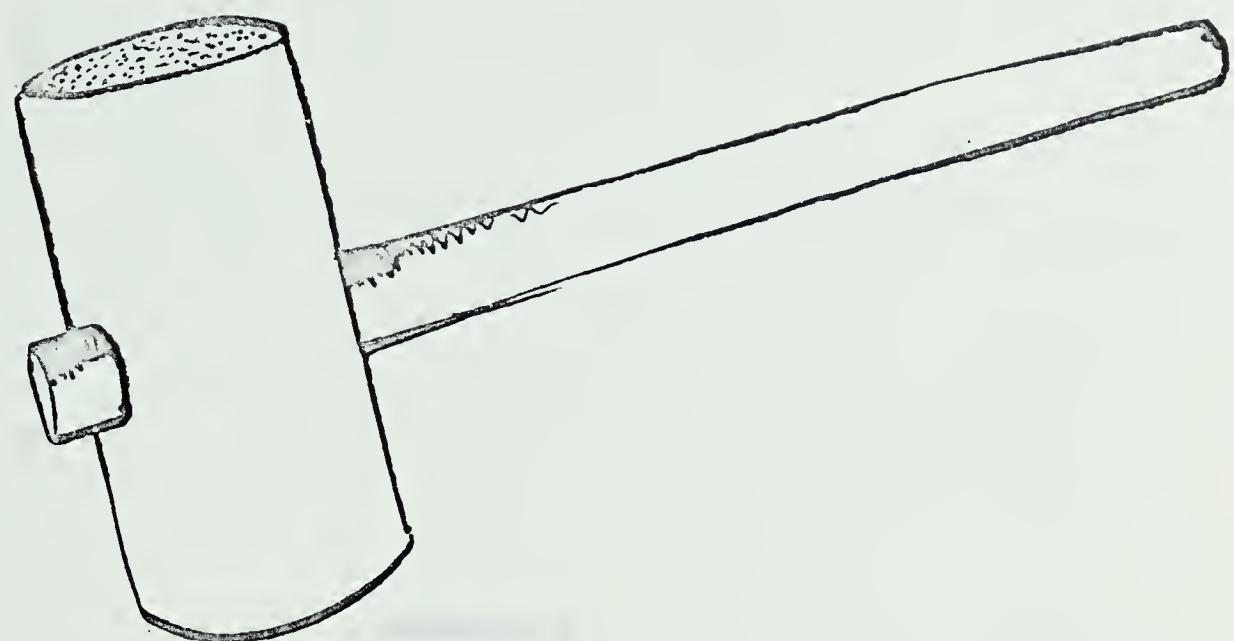












APPENDIX D

Score Sheet

School _____

Subject _____

Date _____

Treatment group _____

Post-test group _____

Time _____

Task	Trial	1	2	3	4	5	6	7	8	9	10	11	12	13	//	18	Test
A. Zumap-Quarter															//		
B. Bolap-Captain															//		
C. Goken-Insect															//		
D. Rennet-Wagon															//		
E. Bodkin-Mallet															//		
F. Sagrole-Money															//		
G. Meardon-Zebra															//		
H. Volvap-Jelly															//		
I. Tarop-Keeper															//		
J. Attar-Jewel															//		

APPENDIX E

**Three-Way Analysis of Variance Using
Transformed Errors to Criterion as the Criterion Measure**

THREE-WAY ANALYSIS OF VARIANCE
 WITH ERRORS TO CRITERION
 TRANSFORMED BY ALOG

Source	SS	MS	df	F
A (sex)	0.1896	0.1896	1	0.7316
B (mode)	12.0432	6.0216	2	23.2304
C (delay)	1.1047	0.3682	3	1.4205
AB	0.5441	0.2721	2	1.0495
AC	0.7184	0.2395	3	0.9238
BC	2.2024	0.3671	6	1.4161
ABC	2.6905	0.4484	6	1.7299
Error	<u>24.8845</u>	0.2592	<u>96</u>	
Total	44.3774		119	

p.05 df 2,96 F=3.09

p.01 df 2,96 F=4.82

B29862